

REMARKS

In accordance with the foregoing, claim 1 has been amended. No new matter is presented, and approval and entry are respectfully requested.

Claims 1-8 are pending and under consideration. Reconsideration is respectfully requested.

As seen in the Amendment, Applicants have amended claim 1 to change the lower limit (formerly "0.6") of the intrinsic viscosity $[\eta]$ range to "0.74".

That is, in the instantly amended claim 1, the intrinsic viscosity $[\eta]$ range is from 0.74 to 4 dl/g. Support for the new lower limit value (0.74) is found at page 213, Table 2 (continued), the intrinsic viscosity $[\eta]$ value ("0.74") of Example 3 of the present specification.

THE STATE OF THE ART AND THE FEATURES AND ADVANTAGES OF THE PRESENT INVENTION:

(The present invention is a **breakthrough** technology)

With respect to the technical level of the prior art, attention should be drawn to the following. As described below in detail in connection with the Scardino et al. reference, Scardino et al. clearly teach that (in the **prior art** technology) the cyclic dimer content of a polytrimethylene terephthalate **cannot** be reduced by any measure, either by removing cyclic dimers or by choosing catalysts or other additives. Scardino et al.'s such technical knowledge is well in agreement with the technical level of the prior art mentioned in the below-described (gist of) background information of the present invention.

The present invention has surprisingly made a breakthrough, completely toppling such conventional technical knowledge clearly reflected in, for example, the Scardino et al. reference (i.e., the conventional knowledge that the cyclic dimer content of a polytrimethylene terephthalate **cannot** be reduced by any measure, either by removing cyclic dimers or by choosing catalysts or other additives).

(Gist of the previous explanations on the background information)

The background information of the present invention was already explained in detail in the Applicants' Response (dated February 29, 2008) to the first office action. However, since the background information is important, the gist of the previous explanations is given below.

The polytrimethylene terephthalate (PTT) produced by a **conventional melt**

polymerization process has a problem in that the conventional PTT contains oligomers in an amount as large as from 2.5 to 3.5 % by weight, and about 90 % by weight of the oligomers are a **cyclic dimer** which is a cyclic compound which is formed by a condensation of 2 terephthalic acid molecules. The above-mentioned **cyclic dimer** is formed by the so-called "ring-linear chain **equilibrium** reaction" which occurs at the hydroxyl group-containing terminal portions of a PTT. Therefore, **even when the cyclic dimer is removed** from the PTT by volatilization during the polymerization reaction, **the cyclic dimer is immediately generated again in the same amount as that of the removed cyclic dimer**, thereby causing the loss of the PTT. Thus, it was **conventionally impossible** to produce a PTT containing the unfavorable cyclic dimer in an amount reduced significantly. Thus, the yield of the PTT becomes inevitably low.

As a method for producing a high molecular weight PTT which has an excellent heat stability, there has been proposed a method for producing a PTT by a **solid-phase polymerization process** (in which prepolymer pellets are subjected to a polymerization). In a **solid-phase polymerization process**, the polymerization is performed at low temperatures and, hence, the ring-linear chain equilibrium of the PTT can be displaced in the direction of the formation of the linear dimer unit (derived from the cyclic dimer) at the hydroxyl group-containing terminals of the PTT. For this reason, it has been reported that the solid-phase polymerization process is effective for reducing the cyclic dimer content of PTT.

However, **as a result of the studies of the present inventors, it has been found that**, the **solid-phase polymerization process** poses various **problems**, such as the problem that, even when a PTT having its cyclic dimer content reduced to less than 1 % by weight is produced by the **solid-phase polymerization process**, **the cyclic dimer is rapidly produced** upon melting thereof during the melt-molding of the PTT, and the reduced cyclic dimer content of the PTT **returns to** the cyclic dimer content (about 2.5 to 3.5 % by weight) of the prepolymer prior to the solid-phase polymerization in which the hydroxyl group-containing terminal portions are at the ring-linear chain equilibrium state.

For solving such problems accompanying the **solid-phase polymerization process**, there have been proposed various, improved melt polymerization processes.

However, conventionally, the problems of the prior art have not yet been satisfactorily solved.

In this situation, the present inventors have made extensive and intensive studies with a view toward solving the above-mentioned problems accompanying the prior art, and developing a polytrimethylene terephthalate (PTT) resin. Although the claims are not restricted to any particular use, it may be possible to use the PTT as a raw material for stably producing, on a

commercial scale, a shaped article having high quality (i.e., shaped article which has excellent strength and color, and which is free from the bleeding of the cyclic dimer to the surface of the shaped article, so that the shaped article is suitable for coating with a coating composition or adhesive agent and exhibits excellent adhesion property). As a result, **it has unexpectedly been found** that, when a crude PTT resin (used as a raw material for the PTT resin of a final PTT resin having advantageously low cyclic dimer content) is produced by a specific method, it becomes possible to obtain a crude PTT resin which is **capable of suppressing the formation of the cyclic dimer even when** the crude PTT resin is melted. Further, by **removing the cyclic dimer** from the obtained crude resin in a molten form, it becomes possible to obtain a PTT resin having an intrinsic viscosity $[\eta]$ **as high as** from 0.74 to 4 dl/g, a molecular weight distribution (Mw/Mn) **as narrow as** from 2 to 2.7, a cyclic dimer content **as small as** not greater than 2 % by weight, and a psychometric lightness L-value of from 70 to 100 and a psychometric chroma b*-value of from -5 to 25. One potential and unclaimed benefit is that by using such a PTT resin, it may be possible to produce an excellent shaped article stably on a commercial scale. Specifically, the **shaped article produced** using the polytrimethylene terephthalate resin of the present invention may have **high strength and excellent color**. Further, the shaped article may be substantially **free from the bleeding of the cyclic dimer** to the surface of the shaped article, so that the shaped article is **suitable for coating** with a coating composition or adhesive agent and exhibits **excellent adhesion property**.

The instantly amended **claim 1** of the present application is essentially directed to a polytrimethylene terephthalate resin comprising:

60 to 100 mole % of (a) trimethylene terephthalate recurring units, and

0 to 40 mole % of (b) at least one monomer unit obtained from a comonomer copolymerizable with at least one of the monomers used for forming the trimethylene terephthalate recurring units,

the total molar amount of (a) monomer units and (b) monomer units being 100 mole %, the polytrimethylene terephthalate resin having the following characteristics (A) to (D):

(A) an intrinsic viscosity $[\eta]$ of from **0.74** to 4 dl/g;

(B) a molecular weight distribution (Mw/Mn) of from 2 to 2.7;

(C) a cyclic dimer content of not greater than 2 % by weight, the cyclic dimer being represented by formula (1); and

(D) a psychometric lightness L-value of from 70 to 100 and a psychometric chroma b*-value of from -5 to 25.

Claim 3 of the present application is essentially directed to a method for producing the polytrimethylene terephthalate resin of the present invention, which comprises:

(1) providing a crude trimethylene terephthalate resin in a molten form, said crude trimethylene terephthalate resin comprising:

60 to 100 mole % of (a) trimethylene terephthalate recurring units, and
0 to 40 mole % of (b) at least one monomer unit obtained from a comonomer copolymerizable with at least one of the monomers used for forming the trimethylene terephthalate recurring units,

the total molar amount of (a) monomer units and (b) monomer units being 100 mole %, said crude trimethylene terephthalate resin further comprising a cyclic dimer of formula (1),

said crude trimethylene terephthalate resin having an intrinsic viscosity $[\eta]$ of from 0.2 to 4 dl/g and a cyclic dimer formation index (E) of less than 0.066, said cyclic dimer formation index (E) being defined by formula (3); and

(2) removing, from said crude polytrimethylene terephthalate resin in a molten form, 0.5 % by weight or more, based on the weight of said crude polytrimethylene terephthalate resin, of said cyclic dimer, by volatilization under reduced pressure.

WITH REGARD TO THE REJECTION OF THE CLAIMS

(II-1) (rejection of claims 1 and 2 under 35 USC § 103)

Claims 1 and 2 have been rejected under 35 USC 103(a) as being unpatentable over Kato et al. (WO 99/11709) in view of Scardino et al. (US 2002/0032302). More specifically, the Examiner states as follows:

"Considering Claims 1 and 2: Kato et al. teaches a polytrimethylene terephthalate (1:5-14) resin with an intrinsic viscosity of up to 0.8 dl/g (10:34-37) with a specific example of 0.7 dl/g (Example 2); a cyclic dimer content of less than 2% by weight (abstract) with an example of 1.7% (Example 2) and a b value of 6.2 (Example 2).

Kato et al. teaches a method for producing a polytrimethylene terephthalate comprising providing a molten trimethylene terephthalate resin
Kato et al. also teaches the resin as being made with a titanium catalyst (9:24-31) in the presence of a phosphate (6:11-30). As disclosed in the original specification (page 121) this will produce a resin with the desired E value of less than 0.033.

Kato et al. does not teach the devolatilization as occurring during the melt phase. However, ***Scardino et al. teaches the removing cyclic dimers from the melt polycondensation phase at reduced pressure*** (§0012). Kato et al. and Scardino et al. are combinable as they are concerned with a similar technical difficulty, namely removing cyclic dimers from a polytrimethylene terephthalate resin. ***It would have been obvious*** to a person having ordinary skill in the art at the time of invention to ***have removed the dimer in the melt phase as in Scardino et al.*** in the process of Kato et al., and the motivation to do so would have been to eliminate the need for an extra solid phase devolatilization step, thus reducing process time and cost.”
(emphasis by ***bold/italic*** added).

The Applicants wish to respond as follows.

As described below, contrary to the Examiner's recognition, it is not obvious to the teachings of Kato et al. and Scardino et al.

Attention is drawn to the fact that Scardino et al. clearly teach that (in the **prior art** technology) the cyclic dimer content of a polytrimethylene terephthalate resin cannot be reduced by removing cyclic dimers therefrom. This is quite apparent from the following descriptions of Scardino et al.:

“The cyclic dimer is ***always*** in equilibrium with the polymer at elevated temperatures (about 2.5 wt % during polycondensation and about 1 wt % during solid state polymerization which is carried out at somewhat lower temperatures), so it will be replaced...”

(emphasis added) (see page 1, left-hand column, last line to right-hand column, line 5 of Scardino et al.),

“[0015] The cyclic dimer occurs at levels of about 2.5 % by weight in the melt polymer from the polycondensation step and about 1 % by weight in the final solid stated polymer. At typical polycondensation temperatures below about 275°C., the cyclic dimer content of the PTT melt is ***always*** less than 3.0 weight percent and it's concentration is unaffected by catalysts or other additives.”

(emphasis added) (see page 2, lines 2 to 9 of paragraph [0015] of Scardino et al.), and

“Results are compared to two polymer samples, A and B, prepared similarly... ..

.....
The amount of cyclic dimer in the final polymer was also similar.”

(emphasis added) (see page 3, right-hand column, lines 4 to 6 and lines 19 and 20 of Scardino et al.)

The above-quoted descriptions of Scardino et al. clearly teach that (in the **prior art** technology) the cyclic dimer content of a polytrimethylene terephthalate cannot be reduced by removing

cyclic dimers therefrom.

In view of the above-quoted descriptions of Scardino et al., the skilled person in the art would **never** be motivated to combine the teachings of Kato et al. and Scardino et al. in such a way as to reconstruct the present invention.

Further, attention is especially drawn to the following passage (quoted above) of Scardino et al.:

"At typical polycondensation temperatures below about 275°C., the cyclic dimer content of the PTT melt is **always less than 3.0 weight percent and it's concentration is unaffected by catalysts or other additives.**"
(emphasis added) (see page 2, lines 6 to 9 of paragraph [0015] of Scardino et al.)

That is, Scardino et al. clearly state that the cyclic dimer content of the PTT melt is "**unaffected by catalysts or other additives**".

Thus, simply stated, Scardino et al. clearly teach that (in the **prior art** technology) the **cyclic dimer content** of a polytrimethylene terephthalate **cannot** be **reduced** by **any measure**, either by removing cyclic dimers or by choosing catalysts or other additives.

Such teaching of Scardino et al. is a strong **negative teaching** about the construction of the present invention. Scardino et al. are clearly **teaching away** from the present invention.

Thus, it is quite apparent that the skilled person in the art would **never** be motivated to combine the teachings of Kato et al. and Scardino et al. in such a way as to reconstruct the present invention.

As apparent from the above, any of claims 1 and 2 of the present application has **non-obviousness** over the combined teachings of Kato et al. and Scardino et al.

Further, for more clearly defining the present invention and for increasing the difference of the present invention from the prior art, the Applicants have amended claim 1 to change the lower limit (formerly "0.6") of the intrinsic viscosity $[\eta]$ range to "**0.74**". That is, in the instantly amended claim 1, the intrinsic viscosity $[\eta]$ range is from **0.74** to 4 dl/g. By this amendment to claim 1, the intrinsic viscosity $[\eta]$ range (from **0.74** to 4 dl/g) recited in the instantly amended claim 1 has become **larger** than the intrinsic viscosity $[\eta]$ value (**0.70**) of Example 2 of Kato et al. (in which melt polymerization is used and the cyclic dimer content is 1.7 wt%, which falls within the cyclic dimer content range (not greater than 2 % by weight) recited in claim 1 of the present application).

It is believed that the rejection of claims 1 and 2 over Kato et al. and Scardino et al. has been removed by the above explanations and the amendment.

REJECTION OF CLAIMS 3 TO 8 UNDER 35 USC § 103

Claims 3 to 8 have been rejected under 35 USC 103(a) as being unpatentable over Kato et al. (WO 99/11709) in view of Scardino et al. (US 2002/0032302).

The Applicants wish to respond as follows.

The same explanation as made above in connection with the rejection of claims 1 and 2 under 35 USC 103(a) applies.

As described above, Scardino et al. clearly teach that (in the **prior art** technology) the **cyclic dimer content** of a polytrimethylene terephthalate **cannot** be **reduced** by **any measure**, either by removing cyclic dimers or by choosing catalysts or other additives.

Such teaching of Scardino et al. is a strong **negative teaching** about the construction of the preset invention. Scardino et al. are clearly **teaching away** from the present invention.

Thus, it is quite apparent that the skilled person in the art would **never** be motivated to combine the teachings of Kato et al. and Scardino et al. in such a way as to reconstruct the present invention.

The present invention has surprisingly made a **breakthrough**, completely toppling such conventional technical knowledge as clearly reflected in, for example, the Scardino et al. reference.

As apparent from the above, any of claims 3 to 8 of the present application has **non-obviousness** over the combined teachings of Kato et al. and Scardino et al.

Rejection Of Claims 1 To 8 On The Ground Of Double Patenting

Claims 1 to 8 have been rejected on the ground of obviousness-type double patenting as being unpatentable over claims 1 and 9 of U.S. Patent No. 7,198,846 in view of Kato et al. (WO 99/11709) and Scardino et al. (US 2002/0032302).

The Applicants wish to respond as follows.

The same explanation as made above in connection with the rejection of claims 1 and 2 under 35 USC 103(a) applies.

As described above, Scardino et al. clearly teach that (in the **prior art** technology) the **cyclic dimer content** of a polytrimethylene terephthalate **cannot** be **reduced** by **any measure**, either by removing cyclic dimers or by choosing catalysts or other additives.

Such teaching of Scardino et al. is a strong **negative teaching** about the construction of the preset invention. Scardino et al. are clearly **teaching away** from the present invention.

Thus, it is quite apparent that the skilled person in the art would **never** be motivated to

combine the teachings of U.S. Patent No. 7,198,846, Kato et al. and Scardino et al. in such a way as to reconstruct the present invention.

The present invention has surprisingly made a **breakthrough**, completely toppling such conventional technical knowledge as clearly reflected in, for example, the Scardino et al. reference.

As apparent from the above, any of claims 1 to 8 of the present application has **non-obviousness** over the combined teachings of U.S. Patent No. 7,198,846, Kato et al. and Scardino et al.

WITH RESPECT TO THE ITEM “*RESPONSE TO ARGUMENTS*”

In the item “*Response to Arguments*” (at page 7, line 11 to page 8, line 5 of the office action), the Examiner states as follows:

A) Applicants argument that Kato et al. does not teach the claimed E value is not persuasive. As discussed above Kato et al. also teaches the resin as being made with a titanium catalyst (9:24-31) in the presence of a phosphate (6:11-30). As disclosed in the original specification (page 121) this will produce a resin with the desired E value of less than 0.033.

B) Applicants argument that the solid phase polymerization is required step of Kato et al. is not persuasive. Kato et al. teaches several examples without the use of a solid phase polymerization (examples 1-7) versus only one with a solid phase polymerization step (Example 8). Therefore a person having ordinary skill in the art at the time of invention would not consider this to be a necessary step in the production of the invention.”

The Applicants wish to respond as follows.

With respect to the above-quoted item **A)** of the section “*Response to Arguments*” of the office action, the Applicants wish to state as follows.

Kato et al. have **no** technical concept of **cyclic dimer formation index (E)**, i.e., **E-value**. Kato et al. have **no** technical concept of controlling **E-value**. Kato et al. have **no** recognition of the critical importance of an **E-value** falling in a specific range as recited in claim 4 of the present application.

With respect to the above-quoted item **B)** of the section “*Response to Arguments*” of the office action, the Applicants wish to state as follows.

At pages 47 and 48 of the Applicants' Response (dated February 29, 2008) to the first

office action, concerning the significance of the **solid-phase** polymerization technique in Kato et al., the Applicants stated as follows:

“Furthermore, it should be noted that, in the Kato et al. reference, the solid-phase polymerization technique (used in Example 8 of Kato et al.) is recognized as very important. This is apparent from, for example, the following description of Kato et al.:

‘To attain an intrinsic viscosity of 0.81 or more, a method of using solid phase polymerization is preferably used. The solid phase polymerization is advantageous in that the intrinsic viscosity can be elevated and also in that the cyclic dimer escapes from the resin composition during the solid phase polymerization because the cyclic dimer has sublimability, and thereby the amount of cyclic dimer can be reduced to 2 wt % or less, preferably 1 wt % or less.

.....’
(emphasis added) (see column 10, lines 40 to 59 of Kato et al.)

Thus, it is apparent that **Example 8 of Kato et al.** (employing a **solid-phase** polymerization process) is a **most preferred** embodiment (giving optimal results) of **Kato et al.**

Therefore, in view of the fact that the present invention is **superior to Example 8 of Kato et al.**, it is quite apparent that the present invention is **superior to any of all** embodiments of **Kato et al.**”

First, it is believed that the Applicants’ above-quoted contention (i.e., the contention that “in the **Kato et al.** reference, the **solid-phase** polymerization technique (used in **Example 8 of Kato et al.**) is recognized as very **important**”) is completely correct and has no logical defects.

Second, it should be noted that in the first office action, the Examiner pointed out as follows:

“Kato teaches a polyester resin comprising 98 wt.% polytrimethylene terephthalate (PTT), 0.9 wt.% cyclic dimer and having an intrinsic viscosity of 1.1 dl/g and a b* value of 0.1 (Table 1, Examples 1 and 8).”
(emphasis added)

That is, the Examiner picked up **Example 8 of Kato et al.** in which an intrinsic viscosity of (as high as) “1.1 dl/g” and a cyclic dimer content of (as low as) “0.9 wt.%” are attained using the **solid-phase** polymerization technique. The intrinsic viscosity of “1.1 dl/g” in **Example 8 of Kato et al.** (using the **solid-phase** polymerization) is a **highest** (best) value in the Working Examples

of Kato et al. The cyclic dimer content of "0.9 wt.%" in **Example 8** of Kato et al. (using the ***solid-phase*** polymerization) is a **lowest** (best) value in the Working Examples of Kato et al. For easy reference, the information of the polymerization methods, intrinsic viscosity values, and cyclic dimer contents of Examples 1 to 9 of Kato et al. (collected from TABLE 1 at columns 15 and 16 of Kato et al.) is indicated in Table A below.

Table A
(information of Examples 1 to 9 of Kato et al.)

Example No.	polymerization method	intrinsic viscosity (dl/g)	cyclic dimer content (wt%)
1	melt polymerization	0.70	2.4
2	melt polymerization	0.70	1.7
3	melt polymerization	0.71	2.2
4	melt polymerization	0.62	2.1
5	melt polymerization	0.79	2.1
6	melt polymerization	0.78	2.2
7	melt polymerization	0.68	2.1
8	solid-phase polymerization	1.10	0.9
9	melt polymerization	0.80	2.4

Thus, in the Working Examples of Kato et al., the **solid-phase** polymerization is used **only** in **Example 8**, and **Example 8** exhibits both a **highest** (best) value (1.10 dl/g) of intrinsic viscosity and a **lowest** (best) value (0.9 wt%) of cyclic dimer content. It is quite apparent that in Kato et al., **Example 8** thereof (using the **solid-phase** polymerization) is recognized as being a **most preferred** embodiment.

In addition, as mentioned above, Kato et al. expressly state the **preference** for the **solid-phase** polymerization, as follows:

"To attain an intrinsic viscosity of 0.81 or more, a method of using solid phase polymerization is preferably used. The solid phase polymerization is advantageous in that the intrinsic viscosity can be elevated and also in that the cyclic dimer escapes from the resin composition during the solid phase polymerization because the cyclic dimer has sublimability, and thereby the amount of cyclic dimer can be reduced to 2 wt % or less, preferably 1 wt % or less.

....."

(emphasis added) (see column 10, lines 40 to 59 of Kato et al.)

In view of such disclosure of the general description and the Working Examples of Kato et al., if the skilled person **wants to increase** the intrinsic viscosity to a maximum and/or **reduce** the cyclic dimer content to a minimum, the skilled person would very naturally, readily find out that, in Kato et al., the ***solid-phase*** polymerization appears to be very important and **substantially essential** for the purpose of **increasing** the intrinsic viscosity to a maximum and/or **reducing** the cyclic dimer content to a minimum. Therefore, it is firmly believed that the skilled person wanting to increase the intrinsic viscosity to a maximum and/or reduce the cyclic dimer content to a minimum would very naturally recognize that the ***solid-phase*** polymerization is substantially required step in Kato et al.

As described hereinabove, the skilled person wanting to increase the intrinsic viscosity to a maximum and/or reduce the cyclic dimer content to a minimum would very naturally recognize that the ***solid-phase*** polymerization is substantially required step in Kato et al.

As also described above, Scardino et al. clearly teach that (in the **prior art** technology) the cyclic dimer content of a polytrimethylene terephthalate **cannot** be **reduced** by **any measure**, either by removing cyclic dimers or by choosing catalysts or other additives. Such teaching of Scardino et al. is a strong **negative teaching** about the construction of the preset invention. Scardino et al. are clearly **teaching away** from the present invention.

In view of such irrelevant teaching of Kato et al. and such negative teaching of Scardino et al., it is quite apparent that the skilled person in the art would **not** be motivated to combine the teachings of Kato et al. and Scardino et al. in such a way as to reconstruct the present invention (with or without the additional teaching of U.S. Patent No. 7,198,846).

The present invention has surprisingly made a **breakthrough**, completely toppling the conventional technical knowledge clearly reflected in, for example, the Scardino et al. reference (i.e., the conventional knowledge that the cyclic dimer content of a polytrimethylene terephthalate **cannot** be **reduced** by **any measure**, either by removing cyclic dimers or by choosing catalysts or other additives). This is the **most important point** of the present invention.

CONCLUSION

Thus, it is believed that all rejections and objections have been removed, and the present application is now in condition for allowance.

Reconsideration and early favorable action on the claims are earnestly solicited.

Docket No.: 1806.1007

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Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

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